An Interdisciplinary Sustainability Evaluation of the Skate Fishery in the Gulf of Alaska

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Introduction

Skates are in growing demand worldwide, and the 2008 U.S. landings of skates was estimated at 65 million pounds, worth $11 million[1]. However, many Atlantic Ocean skate stocks are collapsing. Alaska has relatively healthy skate stocks[2] and there is increasing economic pressure to develop directed fisheries for them[3]. Presently, the most frequently landed and exported skates in the Gulf of Alaska are the big (*Raja binoculata*) and longnose skates (*R. rhina*). These species are long-lived, possess slow growth rates and mature late in life, making them vulnerable to overfishing[4]. A small experimental directed state fishery for big and longnose skates in Prince William Sound (PWS), Alaska provides a unique opportunity to study the feasibility of a directed skate fishery as a means of increasing the economic resilience of coastal Alaskan communities. This project will take an interdisciplinary approach to assessing the sustainability of the budding skate fishery in Alaska by 1) examining movement patterns of big and longnose skates, 2) developing a spatially-explicit stock assessment and 3) building a bio-economic model of the skate fishery in the Gulf of Alaska.

Phase 1: Movement Patterns and Habitat Use

Background

- Although age and growth[5] and reproductive biology[6] of big and longnose skates are being studied, there is very little ecological data available.
- The only study of Pacific skate movement found individuals moving >2300 km (**Fig. 1**)[7].
- However, skate landings are managed separately between federal waters (WGOA, CGOA, EGOA) and state waters (Prince William Sound, Cook Inlet) in the Gulf of Alaska.
- Skates are also assumed to have no transfer of biomass among management areas.

Goals

- Determine the movement patterns and habitat use of big and longnose skates.
- Quantify the transfer of skate biomass between management units.

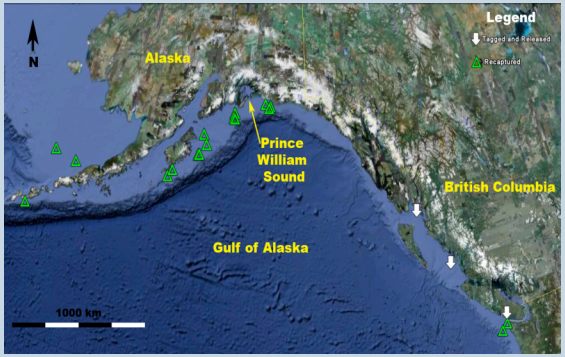

Figure 1. Recapture locations outside of Canadian Waters of big skates tagged in British Columbia. Data from King and McFarlane (2010)[7].

Methods

- I tagged 7 big skates in Prince William Sound in summer 2011 with Mk10 Pop-up Archival Transmitting tags[8] (**Fig. 2a, b**).
- PAT tags will record: depth, temperature and light levels to geolocate skates for one year.
- All other skates were dart tagged with a unique ID code and contact info (**Fig. 2c**).
- Tagging efforts will be continued in Cook Inlet and federal waters of GOA in 2012.
- Tags will be recaptured during subsequent surveys and by the fishing industry.
- Data will be analyzed for habitat use, depth/temperature selection and distance moved.

Expected products

- A greater understanding of the movement and habitat use of big and longnose skates.
- Estimate of the transfer of skate biomass among management areas.

Phase 2: Spatially Explicit Stock Assessment

Background

- Currently, skate landings are managed using abundance estimates from surveys.
- Landings are managed separately in federal (NMFS) and state (ADFG) waters (**Fig. 3**)
- The abundance estimate is not a formal stock assessment and assumes no movement of skates among management areas.

Goals

- Create a spatially explicit stock assessment of big and longnose skates in GOA that incorporates movement information from conventional and satellite tagging data in Phase 1.

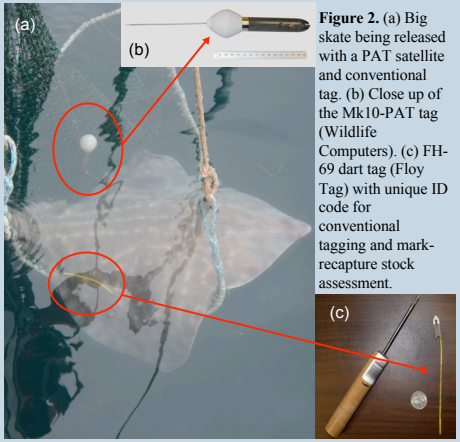

Figure 2. (a) Big skate being released with a PAT satellite and conventional tag. (b) Close up of the Mk10-PAT tag (Wildlife Computers). (c) FH-69 dart tag (Floy Tag) with unique ID code for conventional tagging and mark-recapture stock assessment.

Methods

- Conventional single-tag recovery data from Phase 1 will be analyzed using program MARK[10].
- Abundance will be estimated using an integrated Petersen and Brownie approach[11].
- The model will be extended to include the spatial dynamics[12] examined through PAT tags.

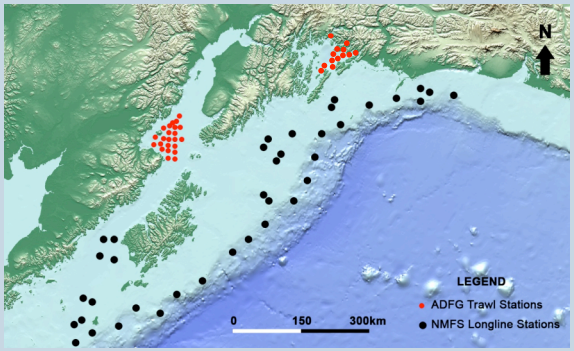

Figure 3. Map of GOA, with the NMFS (black) and ADFG (red) survey stations[9].

Phase 3: Bioeconomic Modeling

Background

- Skates are becoming more desirable after a 2003 price increase to $0.25/lb[13].
- After public pressure, an experimental directed skate fishery was open in PWS in 2009.
- Guideline Harvest Levels (GHL) were exceeded in 2009, additional regulations were implemented in 2010 (**Fig. 4**).
- Opening novel fisheries such as skates may increase the viability of coastal communities.

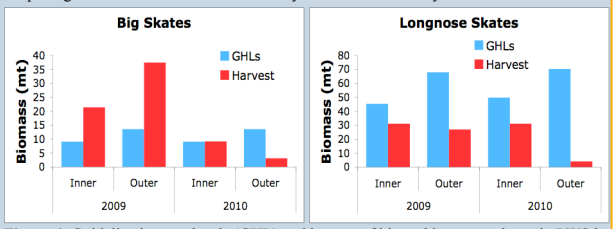

Figure 4. Guideline harvest levels (GHL) and harvest of big and longnose skates in PWS in 2009, when the directed fishery opened, and in 2010[9].

Goals

- Build a bioeconomic model of the directed big and longnose skate fishery in PWS.
- Determine the conditions necessary for a sustainable and profitable Alaska skate fishery.

Methods

- Three general aspects will determine the economic viability of a skate fishery: the sustainable harvest, the demand for skates and the costs associated with fishing for skates.
- Sustainable harvest will depend on the stock assessment N and recruitment R of skates.
- Demand will depend on the price P of skates and the price of substitutes.
- Cost will depend on fuel prices and infrastructure changes C needed to catch and process skates.
- Net revenue to the community will therefore be of the form:

$$NR = f[h(N,R) * d(P_{skates}, P_{sub}) - c(P_{fuel}, C)]$$

- I will collect information on all of these factors to build the bioeconomic model.

Expected products

- A model that will produce revenue estimates to Alaskan fishing communities given sustainable harvest of skates, demand for skates and costs of fishing skates.
- Develop different management scenarios to determine the best harvest strategy.
- A non-target skate fishery may be the most profitable and sustainable harvest strategy.

Synthesis

- Interdisciplinary project: the movement study will inform the spatially-explicit stock assessment which will then be used as a major input in the bioeconomic model
- This project will provide management agencies with important background information to manage the skate fishery before the fishing efforts increase.
- Skates can provide Alaska with another sustainable and profitable fishery.

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Acknowledgements

I would like to thank UAF for support and the National Science Foundation for providing the funding for this research through the Marine Ecosystem Sustainability of the Arctic and Subarctic (MESAS) program.